

**REMARKS**

Claims 1, 2 and 4-10 are rejected; and claim 15 is withdrawn from consideration as being directed to a non-elected invention.

Claim 1 was rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. Particularly, the Examiner considered that claim 1 (i) does not clearly identify what is non-vitrifiable after sintering, and (ii) fails to specify the relationship between the copper paste and the ceramic particle.

Applicants respond as follows.

As discussed bridging pages 9-10 of the substitute specification with respect to (i) above, it is the *ceramic particle* that is non-vitrifiable after sintering. Because the ceramic particle is defined in terms of a Markush grouping, and because all of the members of the Markush group are ceramic particles (that are non-vitrifiable after sintering), claim 1 (and also claim 15) has been amended to delete “non-vitrifiable after sintering” as not further limiting the subject matter of the claim.

As to (ii) above, claim 1 clearly recites that the copper paste comprises (1) copper powder, (2) an organic vehicle, (3) an SiO<sub>2</sub> particle having an average particle size of 50 nm or less, and (4) a ceramic particle having an average particle size of 100 nm or less selected from the group consisting of Al<sub>2</sub>O<sub>3</sub>, TiO<sub>2</sub>, CeO<sub>2</sub> and mullite.

It is respectfully submitted that the claims as amended fully comply with 35 U.S.C. § 112, and withdrawal of the foregoing rejection is respectfully requested.

Applicants further comment on the effect of the ceramic particle selected from Al<sub>2</sub>O<sub>3</sub>, TiO<sub>2</sub>, CeO<sub>2</sub> and mullite of claim 1 as follows.

The ceramic particle ( $\text{Al}_2\text{O}_3$ ,  $\text{TiO}_2$ ,  $\text{CeO}_2$  or mullite) is not vitrifiable when sintered so that migration of glass to the surface of the conductor layer is prevented. Consequently, plating failure (i.e., where the surface remains unplated because glass is present at the surface) due to migration of glass to the conductor surface can be prevented. This effect is described at page 5 of the present specification. The ceramic particle ( $\text{Al}_2\text{O}_3$ ,  $\text{TiO}_2$ ,  $\text{CeO}_2$  or mullite) does not react with additives contained in the ceramic green sheet or copper paste and is not vitrifiable. Unlike glass, the ceramic particle in the sintering process of copper is not fluid. Therefore, the ceramic particle is uniformly dispersed in the conductor layer and does not migrate to the conductor layer surface in the sintering process of copper at the firing step. Therefore, plating failure due to migration of glass to the conductor surface can be prevented.

The above-noted characteristics of the non-vitrifiable ceramic particle are described at pages 9-10 of the specification.

Applicants now address the rejection over prior art as follows.

Claims 1, 2, 4 and 6-10 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent 5,296,189 to Kang et al.

Kang et al was cited as teaching a conductive composition meeting each of the terms of the rejected claims, including copper and alumina particles, which composition may further contain titania ( $\text{TiO}_2$ ) and silica ( $\text{SiO}_2$ ) having the same function as alumina particles.

Applicants respond as follows.

Claim 1 (and also withdrawn claim 15) have been amended to recite that the  $\text{SiO}_2$  particle has an average particle size of less than 50  $\mu\text{m}$ , to thereby exclude Kang et al. from the scope of the amended claims. The average particle size of the  $\text{SiO}_2$  fine particle is described at page 7, lines 18-24 of the substitute specification. Because the specification describes a range of 50 nm

or less, the specification also describes a range of less than 50 nm. See also Table 1 at pages 24-25 of the specification where Examples 1-A to 1-K of the invention all contain  $\text{SiO}_2$  fine particles having an average particle size of less than 50 nm.

More particularly, the amendment to claim 1 excludes the range of from "0.05 to 0.1  $\mu\text{m}$ " for  $\text{Al}_2\text{O}_3$  disclosed by Kang et al., where silica ( $\text{SiO}_2$ ) is said to have the same function as alumina particles.

The significance thereof is as follows.

The function of the  $\text{SiO}_2$  particle of the present invention is different from Kang et al. In more detail, because the  $\text{SiO}_2$  particle of amended claim 1 has an average particle size of less than 50 nm, when the copper paste and the ceramic green sheet are simultaneously fired, the sintering initiating temperature and sintering shrinkage timing each is controlled to approximate values intermediate to those of copper and ceramic green sheet. This provides an operational effect in that a wiring board free of warping or waving, having a high density and low resistance and reduced high-frequency transmission loss can be obtained. This effect is discussed in the paragraph bridging pages 6-7 and in the first full paragraph at page 21 of the substitute specification.

On the other hand, the silica of Kang et al. is used to control grain growth by retarding sintering (column 4, lines 30-35), entirely different from the present invention as discussed above. Moreover, Kang et al. does not disclose the particle size of the silica when used to control grain growth by retarding sintering. Regarding this last point, the Examiner relies on Kang et al. with respect to the starting size of the alumina particles of from about 0.05 to about 0.1  $\mu\text{m}$  (column 4, lines 37-39).

The fact that Kang et al. fails to disclose an average particle size for the silica retardant means that Kang et al. does not disclose each and every element of present claim 1. Accordingly, for this reason alone, it is respectfully submitted that the present claims are not anticipated by Kang et al.

However, to further clarify this distinction, claim 1 has been amended to recite that the SiO<sub>2</sub> particle has an average particle size of less than 50 nm so as to exclude any overlap with the lower limit of 0.05 µm *for Al<sub>2</sub>O<sub>3</sub>* (assuming *arguendo* that the particle size of Al<sub>2</sub>O<sub>3</sub> as a retardant is also applicable to silica when used as a retardant).

Therefore, amended claim 1 defines novel subject matter, and there is no apparent reason to one of ordinary skill in the art to decrease the particle size of the retardant of Kang et al. below the lower limit of 0.05 µm such that the amended claims are also patentable over Kang et al.

In view of the amendment to the claims and the following remarks, it is respectfully submitted that claims 1, 2, 4 and 6-10 are not anticipated by Kang et al., and withdrawal of the foregoing rejection under 35 U.S.C. § 102(b) is respectfully requested.

Moreover, entry of the amendment at this stage of prosecution is respectfully requested as placing the case in condition for allowance.

In paragraph 5 at pages 4-5 of the Office Action, claim 5 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Kang et al. Kang et al was cited as disclosing a ceramic substrate formed of crystallizable glass particles densified to form a green sheet, which crystallizable glass particles can include an alkali metal oxide. The Examiner considered that choosing a workable amount of alkali metal oxide in the green sheet would involve no more than routine experimentation.

Applicants rely on the response above with respect to the rejection of claims 1, 2, 4 and 6-10 over Kang et al.

**Request for Rejoinder:**

Additionally, withdrawn method claim 15 has been amended to include all of the limitations of amended claim 1. Applicants respectfully request rejoinder upon allowance of the product claims.

Withdrawal of all rejections and allowance of claims 1, 2, 4-10 and 15 is earnestly solicited.

In the event that the Examiner believes that it may be helpful to advance the prosecution of this application, the Examiner is invited to contact the undersigned at the local Washington, D.C. telephone number indicated below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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